(19)日本国特許庁（ＪＰ）　(12) **公開特許公報**（Ａ）　(11)特許出願公開番号

**特開平9−109010**

(43)公開日　平成９年(1997)４月28日

| (51)Int.Cl.$^6$ | 識別記号 | 庁内整理番号 | F I | 技術表示箇所 |
|---|---|---|---|---|
| B24B　9/00 | | | B24B　9/00 | L |
| H01L　21/304 | 321 | | H01L　21/304 | 321M |
| | | | | 321E |

審査請求　未請求　請求項の数３　ＯＬ　（全 ７ 頁）

(21)出願番号　特願平8−135422

(22)出願日　平成８年(1996)５月29日

(31)優先権主張番号　特願平7−153813

(32)優先日　平７(1995)５月29日

(33)優先権主張国　日本（ＪＰ）

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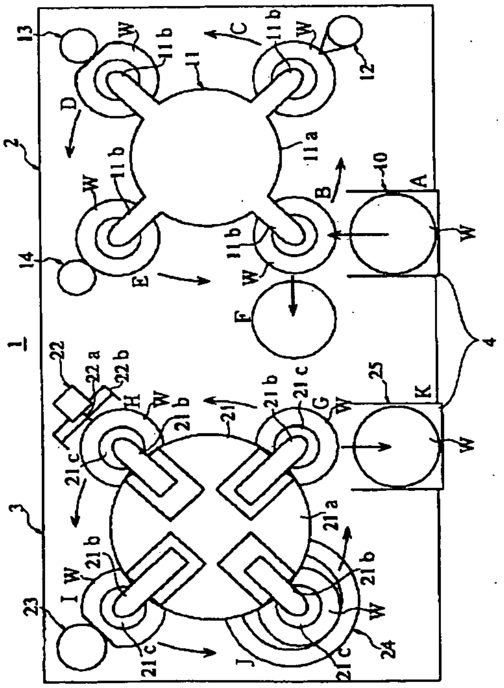
(54)【発明の名称】　ウェーハ外周部の鏡面研磨方法および鏡面研磨装置

(57)【要約】
【課題】　バフ研磨よりはるか短時間で、かつ安定して、平滑な研磨をすることができる鏡面研磨方法および鏡面研磨装置を提供する。
【解決手段】　ウェーハ外周部を鏡面研磨するにあたり、砥粒を担持したテープを用いて前記ウェーハ外周部を研磨した後に、研磨剤を用いてバフによって前記ウェーハ外周部を研磨するようにしたことを特徴とする。



【特許請求の範囲】

【請求項１】　ウェーハ外周部を鏡面研磨するにあたり、砥粒を担持したテープを用いて前記ウェーハ外周部を研磨した後に、研磨剤を用いてバフによって前記ウェーハ外周部を研磨するようにしたことを特徴とするウェーハ外周部の鏡面研磨方法。

【請求項２】　ウェーハ外周部に面取りを施しアルカリエッチを行った後、そのウェーハ外周部を鏡面研磨するにあたり、砥粒を担持したテープを用いて前記ウェーハ外周部を研磨した後に、研磨剤を用いてバフによって前記ウェーハ外周部を研磨するようにしたことを特徴とするウェーハ外周部の鏡面研磨方法。

【請求項３】　砥粒を担持したテープを用いてウェーハ外周部を研磨するテープ研磨装置と、研磨剤を用いてバフによって前記ウェーハ外周部を研磨するバフ研磨装置とを備えたことを特徴とする鏡面研磨装置。

【発明の詳細な説明】

【０００１】

【発明の属する技術分野】本発明は、ウェーハ、特にシリコン半導体ウェーハに適した鏡面研磨装置に関するものである。

【０００２】

【従来の技術】従来、シリコン半導体ウェーハの製造にあたっては、ウェーハ外周部の欠けを防止するための面取り工程、ウェーハの厚さバラツキをなくすためのラッピング工程、破砕層および汚染した部分をなくすためのエッチング工程の後に、ウェーハの鏡面研磨が行われている。このウェーハの鏡面研磨工程は、ウェーハ表面の鏡面研磨工程と、ウェーハ外周部の鏡面研磨工程とに大別できる。

【０００３】ところで、ウェーハ外周部には、ウェーハの結晶方位と関係した位置にオリエンテーションフラット（以下「オリフラ」という）やノッチが設けられ、これらオリフラやノッチは、自動化された製造装置でウェーハ外周上の位置を検出するのに利用されている。したがって、ウェーハ外周部の鏡面研磨工程でも、オリフラやノッチと、それ以外の部分（以下「外周」という）を鏡面研磨することが必要となる。

【０００４】次に、従来の、シリコン単結晶ウェーハのウェーハ外周部の鏡面研磨の方法について説明する。この方法は発泡樹脂製のバフを用いるものである。この方法は、ウェーハの外周やオリフラを、その外周やオリフラの形状に合致する溝（総形溝）を有するバフでもって鏡面研磨するものであり、その鏡面研磨にあたっては、きわめて細かい$SiO_2$粉等を水酸化ナトリウム（ＮａＯＨ）等の水溶液に溶かした研磨剤が用いられる。なお、この方法でノッチを鏡面研磨するには、円板状のバフが用いられる。勿論、この場合にも研磨剤が用いられる。

【０００５】

【発明が解決しようとする課題】ところで、シリコン半導体ウェーハのエッチング方法として、従来、フッ酸、硝酸および酢酸の混合液にウェーハを浸す、いわゆる酸エッチが行われていたが、酸エッチでは、ラッピング後のウェーハの平坦度保持が困難であること、使用後のエッチング液の廃液処理にコストがかかることから、最近では、酸エッチに代わり、アルカリエッチが主流になってきている。しかし、アルカリエッチとした場合、ウェーハの背面や外周面が荒れるので平滑度が損なわれ、背面処理や外周面処理が必要となり、特に外周面処理では、面の粗さを所定の粗さ以下にして目標の平滑度とするための時間が酸エッチに比べて数倍大きくなってしまうという問題があった。

【０００６】本発明は、かかる点に鑑みなされたものであり、バフ研磨よりはるか短時間で、かつ安定して、平滑な研磨をすることができる鏡面研磨方法および鏡面研磨装置を提供することを目的としている。

【０００７】

【課題を解決するための手段】本発明者は、かかる目的達成のため、バフによる研磨だけでなく、現在一部で用いられているテープ研磨についての研究を行った。このテープ研磨は、砥粒を担持したテープを用いる研磨である。その具体的方法は、テープ繰出しリールから繰り出されたテープをウェーハ外周部に押し当て、そのテープをテープ巻取りリールで巻き取ることにより常に新面を加工部に接するようにし、かつテープを巻回するドラムを回転させることによりテープとウェーハとの間に鏡面研磨に必要な相対速度を与えることによってウェーハ外周部を鏡面研磨するものである。このバフ研磨とテープ研磨についての研究では、バフ研磨では、所定の粗さ以下の研磨面を得るのにテープ研磨の数倍の時間を必要とし、さらにその時間もバフによってばらつくといった問題があった。一方、テープ研磨では、得られる面粗さに限界があることを見い出した。

【０００８】そこで、本発明者は、ウェーハ外周部を鏡面研磨するにあたり、砥粒を担持したテープを用いて前記外周部を研磨した後に、研磨剤を用いてバフによって研磨すること、つまり、テープ研磨とバフ研磨とを併用することを試みた。その結果、テープ研磨とバフ研磨とを併用する鏡面研磨を用いれば、バフ研磨よりはるか短時間で、かつ安定して、面粗さを所定の粗さ以下にすることができることが分かった。

【０００９】図１は、バフ研磨と、テープ研磨とを比較したものであり、縦軸が平滑度を、横軸が研磨時間を示している。この図１を見ると、テープ研磨では、所定の平滑度まで研磨するための時間が短いが、得られる平滑度に限界があり、バフ研磨では、所定の平滑度まで研磨するための時間は長く、かつバフによってその時間がばらつくが、テープ研磨に比べてより平滑な研磨ができることが分かる。なお、図１の右側に行くに従って粒度の

小さいテープが用いられている。

【００１０】本発明は、かかる知見に基づいてなされたものであり、ウェーハの外周部に面取りを施した後に、そのウェーハの外周部を鏡面研磨するにあたり、砥粒を担持したテープを用いて前記外周部を研磨した後に、研磨剤を用いてバフによって研磨するようにしたものである。

【００１１】また、他の発明は、ウェーハの外周部に面取りを施しアルカリエッチを行った後、そのウェーハの外周部を鏡面研磨するにあたり、砥粒を担持したテープを用いて前記外周部を研磨した後に、研磨剤を用いてバフによって研磨するようにしたものである。

【００１２】さらに、他の発明は鏡面研磨装置に係るものであり、砥粒を担持したテープを用いてウェーハ外周部を研磨するテープ研磨装置と、研磨剤を用いてバフによってウェーハ外周部を研磨するバフ研磨装置とを備えたものである。

【００１３】上記した手段によれば、バフによりウェーハ外周部を研磨する前に、バフ研磨に比べて研磨速度が速いテープ研磨を施せるので、所望の粗さ以下の平滑度にするまでの時間が短縮されることになる。また、テープによりウェーハ外周部をある程度研磨した後に、テープ研磨に比べて緻密な研磨が可能なバフ研磨を施せるので、平滑度の高い研磨が可能となる。

【００１４】

【発明の実施の形態】図２には本発明に係る鏡面研磨装置が示されている。この鏡面研磨装置１はテープ研磨装置２とバフ研磨装置３とを備え、ウェーハ外周部にテープ研磨とバフ研磨とを施せるようになっている。

【００１５】テープ研磨装置２は、ウェーハWを収納したカセット４を取り付けるためのカセット取付け部Aと、カセット４から取り出されたウェーハW（図３および図４）の位置決めを行うウェーハ位置決め部Bと、ウェーハWのノッチN（図３）を研磨するためのノッチ研磨部Cと、ウェーハWのオリフラO（図４）を研磨するためのオリフラ研磨部Dと、ウェーハWの外周を研磨するための外周研磨部Eとを有している。そして、このテープ研磨装置２においては、カセット取付け部Aにローダ１０が設けられ、中央にウェーハ搬送装置１１が設けられている。また、ノッチ研磨部C、オリフラ研磨部Dおよび外周研磨部Eには、それぞれ、ノッチ研磨装置１２、オリフラ研磨装置１３および外周研磨装置１４が設けられている。

【００１６】ローダ１０は、図５に示すように、多数のウェーハWを積層状態に保持可能なカセット４を昇降させる昇降装置（図示せず）と、このカセット４からウェーハWを１枚ずつ取り出すベルトコンベア１０ａとを備え、カセット４の下側に保持されているウェーハWから順にベルトコンベア１０ａによって１枚ずつウェーハWを取り出すことができるようになっている。

【００１７】ウェーハ搬送装置１１は、図２および図６に示すように、鉛直軸を中心に図示しないモータによって回転駆動される回転体１１ａと、この回転体１１ａに設けられた４つのアーム１１ｂとを備えており、各アーム１１ｂは回転体１１ａの内部にある図示されない空気シリンダーによって、所定の時間に所定の力で外方向に押し出される。また、各アーム１１ｂの先端部下側には、図６に示すように吸着盤１１ｃが設けられている。各吸着盤１１ｃは、アーム１１ｂおよび回転体１１ａ内に配設される空気管（図示せず）を通じて、図示しない吸引ポンプに連結されている。また、吸着盤１１ｃはモータ１１ｄによって回転できるようになっている。

【００１８】ノッチ研磨装置１２は、図７に示すように、回転ドラム３０ａおよびテープ支持部材３０ｂを備えており、回転ドラム３０ａ内には、図示はしないが、テープTを繰り出すための繰出し用リールと、テープTを巻き取るための巻取り用リールとが設けられている。繰出し用リールから繰り出されたテープTは回転ドラム３０ａの外側に一旦導かれ、回転ドラム３０ａの外周に螺旋状に巻き掛けられるが、その途中部分が、回転ドラム３０ａ外に位置するテープ支持部材３０ｂに掛けられ、さらに、そのテープTの先は回転ドラム３０ａの内側に導かれ、巻取り用リールに巻き掛けられている。回転ドラム３０ａはモータ３０ｃによって往復回転され、図示しない巻取り用リールはモータ３０ｄによって回転駆動されるようになっている。このノッチ研磨装置１２では、テープ支持部材３０ｂに掛けられたテープTをウェーハWのノッチNに押し当て、モータ３０ｄによって巻取り用リールでテープTを巻き取りつつ、モータ３０ｃによって回転ドラム３０ａを往復回転させて、テープTによってノッチNの研磨を行うようになっている。その際、ノッチNの全体を研磨できるように、吸着盤１１ｃを往復回転させることが好ましい。また、回転ドラム３０ａとテープ支持部材３０ｂとはノッチNに接近・離反できる方向に移動可能な構成とし、さらに、テープTとノッチNとの接触部を通り前記方向に直交する水平軸を中心に回転できるように構成しておくことが好ましい。

【００１９】オリフラ研磨装置１３および外周研磨装置１４は同様の構成となっており、図８に示すように、回転ドラム４０ａを備えており、回転ドラム４０ａ内には、図示はしないが、テープTを繰り出すための繰出し用リールと、テープTを巻き取るための巻取り用リールとが設けられている。繰出し用リールから繰り出されたテープTは回転ドラム４０ａの外側に一旦導かれ、回転ドラム４０ａの外周に螺旋状に巻き掛けられ、さらに、そのテープTの先は回転ドラム４０ａの内側に導かれ、巻取り用リールに巻き掛けられている。また、回転ドラム４０ａはモータ４０ｃによって往復回転され、図示しない巻取り用リールはモータ４０ｄによって回転駆動さ

れるようになっている。このオリフラ研磨装置１３および外周研磨装置１４では、回転ドラム４０ａに掛けられたテープＴをウェーハＷのオリフラＯや外周に押し当て、モータ４０ｄによって巻取り用リールでウェーハＷを巻き取りつつ、モータ４０ｃによって回転ドラム４０ａを往復回転させて、オリフラＯや外周の研磨を行うようになっている。回転ドラム４０ａを、テープＴとオリフラＯや外周との接触部を通り前記方向に直交する水平軸を中心に回転できるように構成し、面取り部全体を研磨できるようにしておくことが好ましい。

【００２０】なお、ウェーハ位置決め部Ｂでは図示しない位置決め装置により、ウェーハＷのセンタリングがなされるようになっている。また、テープ研磨終了の後に、ウェーハ位置決め部Ｂに戻されたウェーハＷは再度位置決めされることなく、図示しない手段によって、ウェーハＷの受渡し部Ｆに送られるようになっている。

【００２１】バフ研磨装置３は、図示しない手段によって受渡し部Ｆから送られてくるウェーハＷ（図３および図４）の位置決めを行うウェーハ位置決め部Ｇと、ウェーハＷのノッチＮ（図３）を研磨するためのノッチ研磨部Ｈと、ウェーハＷのオリフラＯ（図４）を研磨するためのオリフラ研磨部Ｉと、ウェーハＷの外周を研磨するための外周研磨部Ｊと、ウェーハＷを収納するためのカセット４を取り付けるためのカセット取付け部Ｋとを有している。そして、このバフ研磨装置３においては、中央にウェーハ搬送装置２１が設けられている。また、ノッチ研磨部Ｈ、オリフラ研磨部Ｉおよび外周研磨部Ｊには、それぞれ、ノッチ研磨装置２２、オリフラ研磨装置２３および外周研磨装置２４が設けられている。さらに、カセット取付け部Ｋにはアンローダ２５が設けられている。

【００２２】ウェーハ搬送装置２１はウェーハ搬送装置１１とほぼ同様な構成となっていて、図２に示すように、鉛直軸を中心に図示しないモータによって回転駆動される回転体２１ａと、この回転体２１ａに設けられた４つのアーム２１ｂとを備えており、各アーム２１ｂは回転体２１ａの内部にある図示されない空気シリンダーによって、所定の時間に所定の力で外方向に押し出される。また、各アーム２１ｂの先端部下側には吸着盤２１ｃが設けられている。各吸着盤２１ｃは、アーム２１ｂおよび回転体２１ａ内に配設される空気管（図示せず）を通じて、図示しない吸引ポンプに連結されている。また、吸着盤２１ｃは図示しないモータによって回転できるようになっている。

【００２３】ノッチ研磨装置２２は、図２に示すように、円板状の発泡樹脂製のバフ２２ａを備えており、このバフ２２ａは上方から見て「コ」字状のアーム２２ｂに支持されている。そして、このノッチ研磨装置２２では、バフ２２ａは図示しないモータによって回転駆動されるようになっており、バフ２２ａの外周をウェーハＷのノッチＮに押し当て、ウェーハＷを小角度往復回転させることによって、ウェーハＷのノッチＮが研磨される。

【００２４】オリフラ研磨装置２３は、図９に示すように、円柱状の発泡樹脂製のバフ２３ａを備えている。このバフ２３ａの外周には、ウェーハＷのオリフラＯを受容する溝（総形溝）２３ｂが設けられている。バフ２３ａはモータ２３ｃによって回転駆動されるようになっていると共に、図示しない昇降装置によって上下動できるようになっており、バフ２３ａの溝２３ｂの内面をウェーハＷのオリフラＯに押し当てることによって、ウェーハＷのオリフラＯを研磨するようになっている。

【００２５】外周研磨装置２４は、図１０に示すように、円筒状の発泡樹脂製のバフ２４ａを備えている。このバフ２４ａの内周には、ウェーハＷの外周を受容する溝（総形溝）２４ｂが設けられている。バフ２４ａはモータ２４ｃによって回転駆動されるようになっていると共に、図示しない昇降装置によって上下動できるようになっており、バフ２４ａの溝２４ｂの内面をウェーハＷの外周に押し当てることによって、ウェーハＷの外周を研磨するようになっている。

【００２６】アンローダ２５は、図１１に示すように、多数のウェーハＷを積層状態に保持可能なカセット４を昇降させる昇降装置（図示せず）と、このカセット４にウェーハＷを１枚ずつ収納するベルトコンベア２５ａとを備え、カセット４の上側から順にウェーハＷをベルトコンベア２５ａによって１枚ずつウェーハＷを収納することができるようになっている。

【００２７】なお、ウェーハ位置決め部Ｇでは図示しない位置決め装置により、ウェーハＷのセンタリングがなされるようになっている。

【００２８】このように構成された鏡面研磨装置１によれば、テープ研磨とバフ研磨の双方を行えると共に、必要に応じて、テープ研磨若しくはバフ研磨の一方だけを行うことができる。そして、テープ研磨とバフ研磨の双方を行う場合には、バフ研磨よりはるか短時間で、かつ、安定して、面粗さを所望の粗さ以下にすることができる。

【００２９】以上、本発明者によってなされた発明の実施形態について説明したが、本発明は、かかる実施形態に限定されるものではなく、その要旨を逸脱しない範囲において種々の変形が可能である。

【００３０】

【発明の効果】本発明の代表的なものの効果を説明すれば、バフによりウェーハ外周部を研磨する前に、バフ研磨に比べて研磨速度が速いテープ研磨を施せるので、所定の粗さ以下の平滑度にするまでの時間が短縮されることになる。また、テープによりウェーハ外周部をある程度研磨した後に、テープ研磨に比べて緻密な研磨が可能なバフ研磨を施せるので、テープ研磨だけでは困難な、

所望の粗さ以下の研磨が可能となる。

【図面の簡単な説明】

【図１】本発明に係るテープ研磨とバフ研磨との平滑度および研磨時間を比較して示す図表である。

【図２】本発明の実施形態の鏡面研磨装置の平面図である。

【図３】ノッチ付きのウェーハの平面図である。

【図４】オリフラ付きのウェーハの平面図である。

【図５】本発明の実施形態のテープ研磨装置におけるローダの側面図である。

【図６】本発明の実施形態の研磨装置におけるウェーハ搬送装置の一部を示す斜視図である。

【図７】本発明の実施形態のテープ研磨装置におけるノッチ研磨装置の斜視図である。

【図８】本発明の実施形態のテープ研磨装置におけるオリフラ研磨装置および外周研磨装置の斜視図である。

【図９】本発明の実施形態のバフ研磨装置におけるオリフラ研磨装置の側面図である。

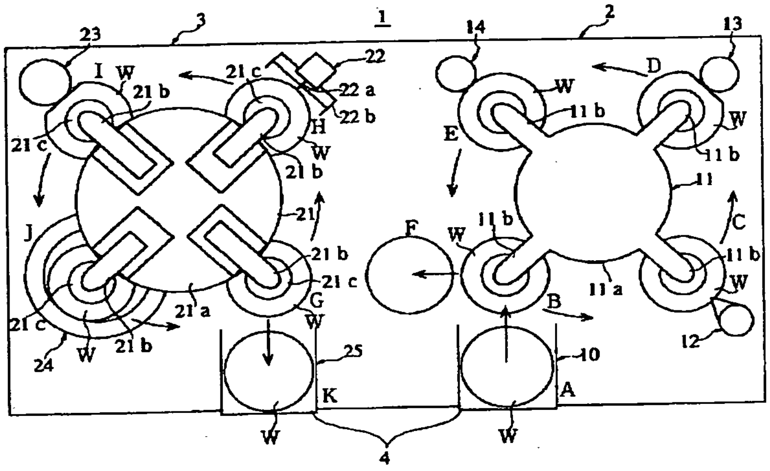
【図１０】本発明の実施形態のバフ研磨装置における外周研磨装置の斜視図である。

【図１１】本発明の実施形態のバフ研磨装置におけるアンローダの側面図である。

【符号の説明】

| | |
|---|---|
| １ | 鏡面研磨装置 |
| ２ | テープ研磨装置 |
| ３ | バフ研磨装置 |
| ４ | カセット |
| １０ | ローダ |
| １１，２１ | ウェーハ搬送装置 |
| １２，２２ | ノッチ研磨装置 |
| １３，２３ | オリフラ研磨装置 |
| １４，２４ | 外周研磨装置 |
| ２５ | アンローダ |

【図２】



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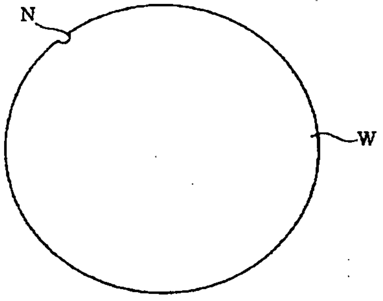

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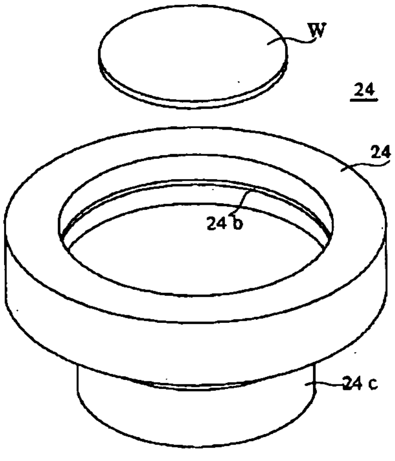

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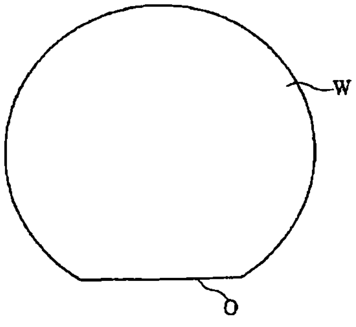

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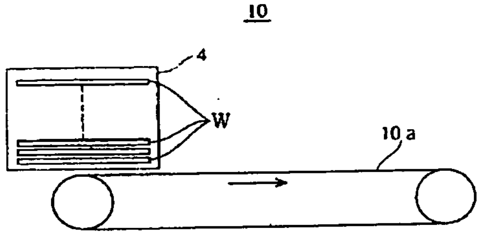

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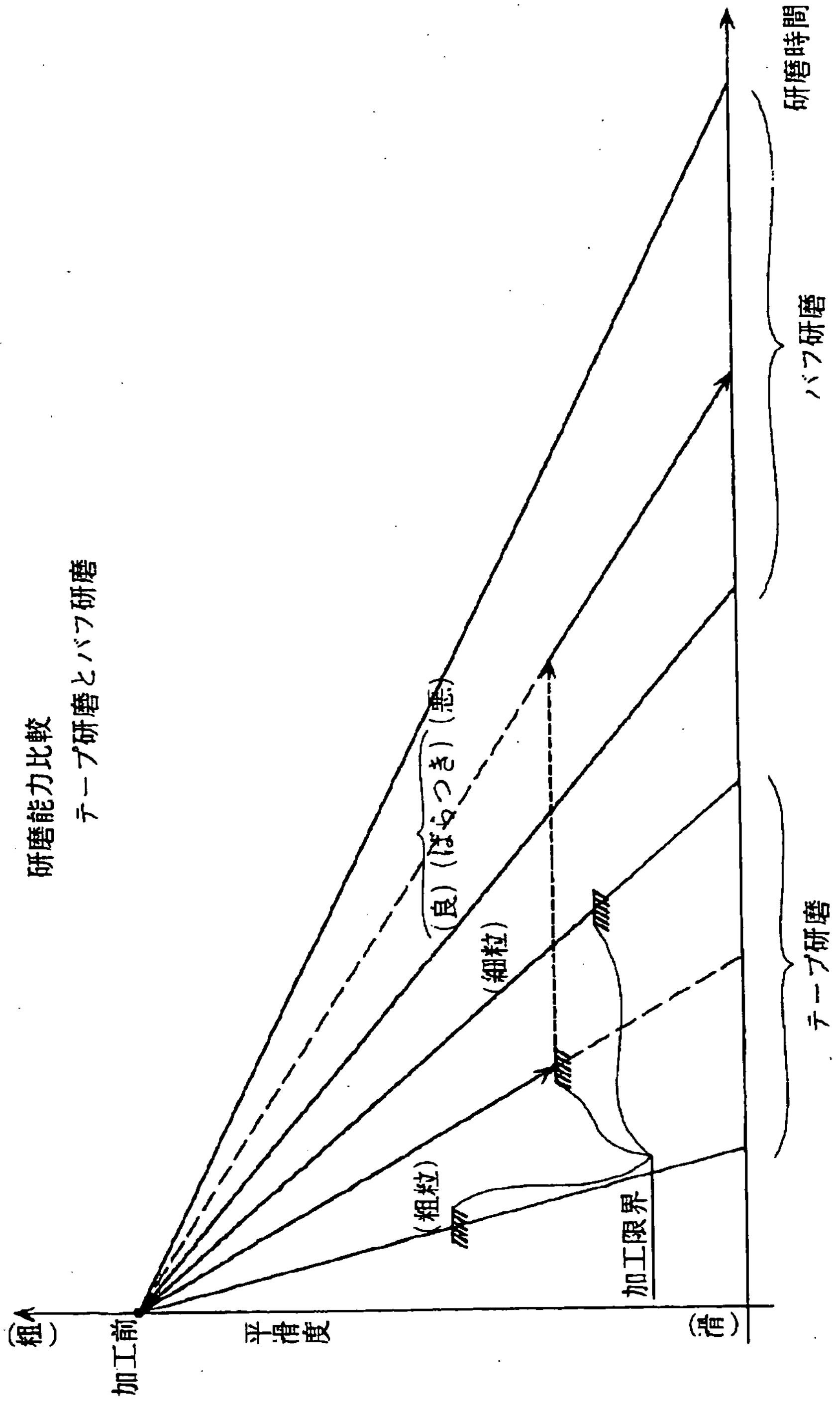
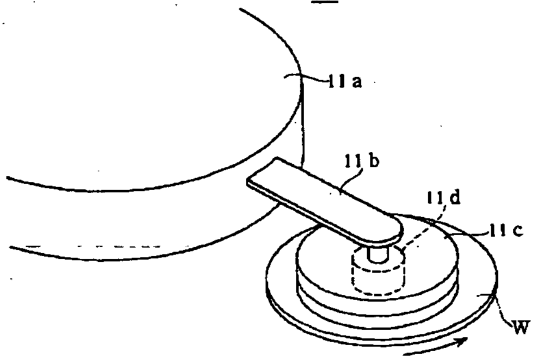

研磨能力比較
テープ研磨とバフ研磨
研磨時間
バフ研磨
テープ研磨
（良）（ばらつき）（悪）
（細粒）
（粗粒）
加工限界
（粗）
加工前
平滑度
（滑）

【図６】



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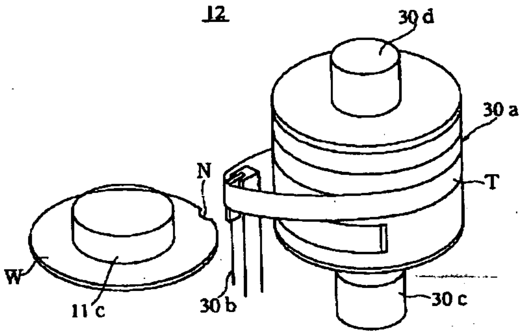

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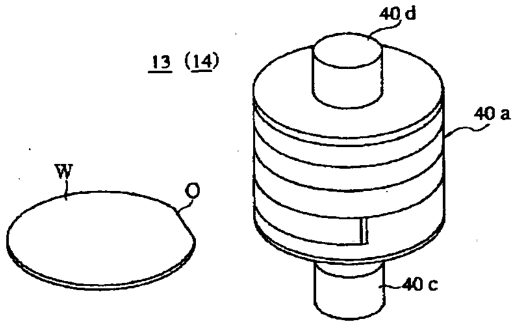

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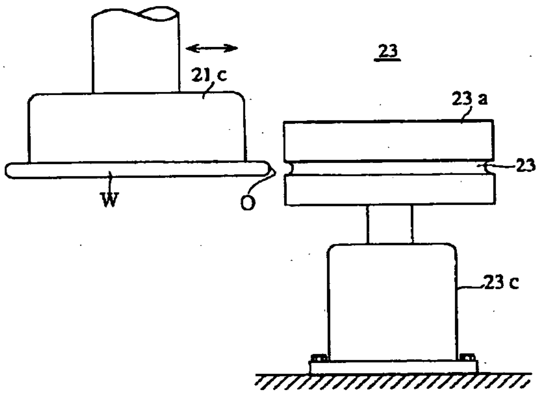

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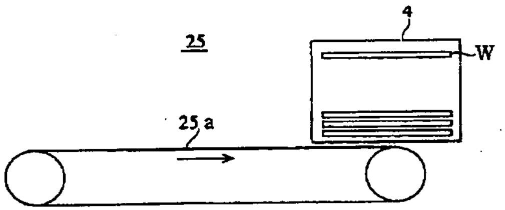

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JAPANESE [JP,09-109010,A]

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CLAIMS DETAILED DESCRIPTION TECHNICAL FIELD PRIOR ART EFFECT OF THE INVENTION TECHNICAL PROBLEM MEANS DESCRIPTION OF DRAWINGS DRAWINGS

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[Translation done.]

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## CLAIMS

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[Claim(s)]
[Claim 1] The mirror-polishing approach of the wafer periphery section characterized by using an abrasive material and grinding said wafer periphery section with a buff after grinding said wafer periphery section using the tape which supported the abrasive grain in carrying out mirror polishing of the wafer periphery section.
[Claim 2] The mirror-polishing approach of the wafer periphery section characterized by using an abrasive material and grinding said wafer periphery section with a buff after grinding said wafer periphery section using the tape which supported the abrasive grain in carrying out mirror polishing of the wafer periphery section after beveling in the wafer periphery section and performing ARUKARIETCHI.
[Claim 3] Mirror-polishing equipment characterized by having the tape polish equipment which grinds the wafer periphery section using the tape which supported the abrasive grain, and buffing equipment which grinds said wafer periphery section with a buff using an abrasive material.

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[Translation done.]

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## DETAILED DESCRIPTION

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[Detailed Description of the Invention]
[0001]
[Field of the Invention] This invention relates to the mirror-polishing equipment suitable for a wafer, especially a silicon semiconductor wafer.
[0002]
[Description of the Prior Art] Conventionally, in manufacture of a silicon semiconductor wafer, mirror polishing of a wafer is performed after the etching process for losing the wrapping process, the crushing layer, and the polluted part for abolishing the beveling process for preventing the chip of the wafer periphery section, and the thickness variation of a wafer. The mirror-polishing process of this wafer can be divided roughly into the mirror-polishing process on the front face of a wafer, and the mirror-polishing process of the wafer periphery section.
[0003] By the way, an orientation flat (henceforth a "cage hula") and a notch are prepared in the location related to the crystal orientation of a wafer at the wafer periphery section, and these cage hula and the notch are used for detecting the location on a wafer periphery by the automated manufacturing installation. Therefore, it is necessary to carry out mirror polishing of the other part (henceforth a "periphery") to a cage hula or a notch also at the mirror-polishing process of the wafer periphery section.
[0004] Next, the approach of mirror polishing of the conventional wafer periphery section of a silicon single crystal wafer is explained. This approach uses the buff made of foaming resin. This approach is very fine SiO2, if mirror polishing is carried out to it being also with the buff which has the slot (the total ****) which agrees the periphery and cage hula of a wafer in the configuration of that periphery and cage hula and that mirror polishing is hit. The abrasive material which melted powder etc. in water solutions, such as a sodium hydroxide (NaOH), is used. In addition, in order to carry out mirror polishing of the notch by this approach, a disc-like buff is used. Of course, an abrasive material is used also in this case.
[0005]
[Problem(s) to be Solved by the Invention] by the way, the so-called acid dirty **** crack ****** which dips a wafer in the mixed liquor of fluoric acid, a nitric acid, and an acetic acid conventionally as the etching approach of a silicon semiconductor wafer -- an acid -- recently [ if dirty since cost starts waste fluid processing of the etching reagent after that display flatness maintenance of the wafer after wrapping is difficult and an activity ] -- an acid -- dirty -- instead of -- alkali dirty ** -- it is becoming in use. however, alkali -- the time amount for smoothness being spoiled since the tooth back and peripheral face of a wafer are ruined, and backing and peripheral face processing being needed, especially making granularity of a field below into predetermined granularity by peripheral face processing, and considering as target smoothness, when dirty -- an acid -- there was a problem of comparing dirtily and becoming large several times.
[0006] This invention is made in view of this point, from buffing, it is a short time far, and is stabilized, and aims at offering the mirror-polishing approach and mirror-polishing equipment which can carry out smooth polish.
[0007]

[Means for Solving the Problem] this invention person did not only the polish by the buff but research on the tape polish used by current [ part ] for this object achievement. This tape polish is polish using the tape which supported the abrasive grain. The concrete approach carries out mirror polishing of the wafer periphery section to mirror polishing by giving a required relative velocity between a tape and a wafer by rotating the drum which presses against the wafer periphery section the tape which it let out from the supply reel, and a new side is made to always touch the processing section by rolling round the tape by the forward-tape-wind-without-data-read-without-machine-functions reel, and winds a tape. In the research on this buffing and tape polish, at buffing, several times as much time amount as tape polish was needed for acquiring the polished surface below predetermined granularity, and there was a problem that that time amount also varied with a buff further. On the other hand, in tape polish, it found out that a limitation was in the field granularity obtained.

[0008] Then, this invention person tried to use an abrasive material and to grind with a buff, i.e., to use tape polish and buffing together, after grinding said periphery section using the tape which supported the abrasive grain in carrying out mirror polishing of the wafer periphery section. Consequently, when using mirror polishing which uses tape polish and buffing together, it turned out that it is a short time far, and it is stabilized, and field granularity can be made below into predetermined granularity from buffing.

[0009] Drawing 1 compares buffing with tape polish, an axis of ordinate shows smoothness and the axis of abscissa shows polish time amount. Although a limitation is in the smoothness obtained although the time amount for grinding to predetermined smoothness is short, the time amount for grinding to predetermined smoothness is long and that time amount differs in tape polish with a buff at buffing when this drawing 1 is seen, it turns out that smoother polish can be performed compared with tape polish. In addition, the tape with a small grain size is used as it goes to the right-hand side of drawing 1 .

[0010] After this invention grinds said periphery section using the tape which supported the abrasive grain in carrying out mirror polishing of the periphery section of the wafer after being made based on this knowledge and beveling in the periphery section of a wafer, an abrasive material is used for it and it grinds it with a buff.

[0011] Moreover, after other invention grinds said periphery section using the tape which supported the abrasive grain in carrying out mirror polishing of the periphery section of the wafer after beveling in the periphery section of a wafer and performing ARUKARIETCHI, it uses an abrasive material and grinds it with a buff.

[0012] Furthermore, other invention relates to mirror-polishing equipment, and is equipped with the tape polish equipment which grinds the wafer periphery section using the tape which supported the abrasive grain, and the buffing equipment which grinds the wafer periphery section with a buff using an abrasive material.

[0013] Since according to the above-mentioned means tape polish with a quick polish rate can be given compared with buffing before grinding the wafer periphery section with a buff, time amount until it makes it the smoothness below desired granularity will be shortened. Moreover, since buffing in which precise polish is possible can be given compared with tape polish after grinding the wafer periphery section to some extent on a tape, high polish of smoothness is attained.

[0014]

[Embodiment of the Invention] The mirror-polishing equipment concerning this invention is shown in drawing 2 . This mirror-polishing equipment 1 is equipped with tape polish equipment 2 and buffing equipment 3, and can give tape polish and buffing to the wafer periphery section now.

[0015] The cassette anchoring section A for tape polish equipment 2 to attach the cassette 4 which contained Wafer W The wafer positioning section B which positions the wafer W ( drawing 3 and drawing 4 ) picked out from the cassette 4 It has the periphery polish section E for grinding the periphery of the cage hula polish section D for grinding the cage hula O ( drawing 4 ) of the notch polish section C for grinding the notch N of Wafer W ( drawing 3 ), and Wafer W, and Wafer W. And in this tape polish equipment 2, a loader 10 is formed in the cassette anchoring

section A, and the wafer transport device 11 is formed in the center. Moreover, notch polish equipment 12, cage hula polish equipment 13, and periphery polish equipment 14 are formed in the notch polish section C, the cage hula polish section D, and the periphery polish section E, respectively.
[0016] As shown in drawing 5 , a loader 10 can be equipped with the lifting device (not shown) which makes it go up and down the cassette 4 which can be held in the laminating condition for many wafers W, and band-conveyor 10a which picks out one wafer W at a time from this cassette 4, and can take out one wafer W now at a time by band-conveyor 10a sequentially from the wafer W currently held at the cassette 4 bottom.
[0017] The wafer transport device 11 is equipped with body-of-revolution 11a by which revolution actuation is carried out, and four arm 11b prepared in this body-of-revolution 11a by the motor which is not illustrated focusing on a vertical axis as shown in drawing 2 and drawing 6 , and each arm 11b is extruded by predetermined time amount in the direction of outside by the predetermined force by the air cylinder in the interior of body-of-revolution 11a which is not illustrated. Moreover, as shown in drawing 6 , adhesive disk 11c is prepared in the point bottom of each arm 11b. Each adhesive disk 11c is connected with the suction pump which is not illustrated through the air pipe (not shown) arranged in arm 11b and body-of-revolution 11a. Moreover, adhesive disk 11c can be rotated now by motor 11d.
[0018] Although notch polish equipment 12 is equipped with rotating-drum 30a and tape supporter material 30b and does not carry out a graphic display into rotating-drum 30a as shown in drawing 7 , the reel for delivery for letting out Tape T and the reel for rolling up for rolling round Tape T are formed. It is hung on tape supporter material on which part is located out of rotating-drum 30a the middle although tape T which it let out from reel for delivery is once led to outside of rotating-drum 30a and it is spirally wound almost on periphery of rotating-drum 30a 30b, the point of the tape T is further drawn inside rotating-drum 30a, and it is almost wound around the reel for rolling up. The both-way revolution of the rotating-drum 30a is carried out by motor 30c, and revolution actuation of the reel for rolling up which is not illustrated is carried out by motor 30d. With this notch polish equipment 12, pressing against the notch N of Wafer W the tape T hung on tape supporter material 30b, and rolling round Tape T by the reel for rolling up by motor 30d, the both-way revolution of the rotating-drum 30a is carried out by motor 30c, and Notch N is ground on Tape T. In that case, it is desirable to carry out the both-way revolution of the adhesive disk 11c so that the whole notch N can be ground. Moreover, as for rotating-drum 30a and tape supporter material 30b, it is desirable to constitute so that it can rotate centering on the horizontal axis which considers as a configuration movable in the direction which can approach and desert, and intersects perpendicularly with Notch N in said direction through the contact section of Tape T and Notch N further.
[0019] Although it has rotating-drum 40a and a graphic display is not carried out into rotating-drum 40a as cage hula polish equipment 13 and periphery polish equipment 14 have same composition and it is shown in drawing 8 , the reel for delivery for letting out Tape T and the reel for rolling up for rolling round Tape T are formed. The tape T which it let out from the reel for delivery is once led to the outside of rotating-drum 40a, and it is spirally wound around the periphery of rotating-drum 40a almost, and further, the point of the tape T is drawn inside rotating-drum 40a, and is almost wound around the reel for rolling up. Moreover, the both-way revolution of the rotating-drum 40a is carried out by motor 40c, and revolution actuation of the reel for rolling up which is not illustrated is carried out by motor 40d. With this cage hula polish equipment 13 and periphery polish equipment 14, pressing against the cage hula O and periphery of Wafer W the tape T hung on rotating-drum 40a, and rolling round Wafer W by the reel for rolling up by motor 40d, by motor 40c, the both-way revolution of the rotating-drum 40a is carried out, and polish of the cage hula O and a periphery is performed. It is desirable to constitute so that rotating-drum 40a can be rotated centering on the horizontal axis which intersects perpendicularly in said direction through the contact section of Tape T, and the cage hula O and a periphery, and to enable it to grind the whole chamfer.
[0020] In addition, in the wafer positioning section B, centering of Wafer W is made by the pointing device which is not illustrated. Moreover, the wafer W returned to the wafer positioning

section B after tape polish termination is sent to the carrier delivery section F of Wafer W by the means which is not illustrated, without being positioned again.
[0021] The wafer positioning section G which positions the wafer W ( drawing 3 and drawing 4 ) which delivers buffing equipment 3 with the means which is not illustrated, and is sent from Section F The notch polish section H for grinding the notch N of Wafer W ( drawing 3 ) It has the cassette anchoring section K for attaching the cassette 4 for containing the periphery polish section J and Wafer W for grinding the periphery of the cage hula polish section I for grinding the cage hula O of Wafer W ( drawing 4 ), and Wafer W. And in this buffing equipment 3, the wafer transport device 21 is formed in the center. Moreover, notch polish equipment 22, cage hula polish equipment 23, and periphery polish equipment 24 are formed in the notch polish section H, the cage hula polish section I, and the periphery polish section J, respectively. Furthermore, the unloader 25 is formed in the cassette anchoring section K.
[0022] As the wafer transport device 21 has the almost same composition as the wafer transport device 11 and it is shown in drawing 2 , it has body-of-revolution 21a by which revolution actuation is carried out, and four arm 21b prepared in this body-of-revolution 21a by the motor which is not illustrated focusing on a vertical axis, and each arm 21b is extruded by predetermined time amount in the direction of outside by the predetermined force by the air cylinder in the interior of body-of-revolution 21a which is not illustrated. Moreover, adhesive disk 21c is prepared in the point bottom of each arm 21b. Each adhesive disk 21c is connected with the suction pump which is not illustrated through the air pipe (not shown) arranged in arm 21b and body-of-revolution 21a. Moreover, adhesive disk 21c can be rotated now by the motor which is not illustrated.
[0023] Notch polish equipment 22 is equipped with buff 22a made of disc-like foaming resin as shown in drawing 2 , and this buff 22a is seen from the upper part, and is supported by "KO" character-like arm 22b. And with this notch polish equipment 22, the notch N of Wafer W is ground by carrying out revolution actuation of the buff 22a by the motor which is not illustrated, pressing the periphery of buff 22a against the notch N of Wafer W, and carrying out the both-way revolution of the wafer W whenever [ corniculus ].
[0024] Cage hula polish equipment 23 is equipped with buff 23a made of cylinder-like foaming resin as shown in drawing 9 . Slot (total ****) 23b which receives the cage hula O of Wafer W is prepared in the periphery of this buff 23a. Buff 23a grinds the cage hula O of Wafer W by being able to move up and down now with the lifting device which is not illustrated and pressing the inner surface of slot 23b of buff 23a against the cage hula O of Wafer W while revolution actuation is carried out by motor 23c.
[0025] Periphery polish equipment 24 is equipped with buff 24a made of cylinder-like foaming resin as shown in drawing 10 . Slot (total ****) 24b which receives the periphery of Wafer W is prepared in the inner circumference of this buff 24a. Buff 24a grinds the periphery of Wafer W by being able to move up and down now with the lifting device which is not illustrated and pressing the inner surface of slot 24b of buff 24a against the periphery of Wafer W while revolution actuation is carried out by motor 24c.
[0026] As shown in drawing 11 , an unloader 25 can be equipped with the lifting device (not shown) which makes it go up and down the cassette 4 which can be held in the laminating condition for many wafers W, and band-conveyor 25a which contains one wafer W at a time to this cassette 4, and can contain one wafer W now at a time for Wafer W by band-conveyor 25a sequentially from a cassette 4 upside.
[0027] In addition, in the wafer positioning section G, centering of Wafer W is made by the pointing device which is not illustrated.
[0028] Thus, according to the constituted mirror-polishing equipment 1, while being able to perform the both sides of tape polish and buffing, either tape polish or buffing can be performed if needed. And when performing the both sides of tape polish and buffing, from buffing, it is a short time far, and it is stabilized, and field granularity can be made below into desired granularity.
[0029] As mentioned above, although the operation gestalt of invention made by this invention person was explained, in the range which is not limited to this operation gestalt and does not

deviate from the summary, various deformation is possible for this invention.

[0030]

[Effect of the Invention] Since tape polish with a quick polish rate can be given compared with buffing before grinding the wafer periphery section with a buff if the effectiveness of the typical thing of this invention is explained, time amount until it makes it the smoothness below predetermined granularity will be shortened. Moreover, since buffing in which precise polish is possible can be given compared with tape polish after grinding the wafer periphery section to some extent on a tape, the polish below difficult desired granularity is attained only by tape polish.

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## TECHNICAL FIELD

[Field of the Invention] This invention relates to the mirror-polishing equipment suitable for a wafer, especially a silicon semiconductor wafer.

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## PRIOR ART

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[Description of the Prior Art] Conventionally, in manufacture of a silicon semiconductor wafer, mirror polishing of a wafer is performed after the etching process for losing the wrapping process, the crushing layer, and the polluted part for abolishing the beveling process for preventing the chip of the wafer periphery section, and the thickness variation of a wafer. The mirror-polishing process of this wafer can be divided roughly into the mirror-polishing process on the front face of a wafer, and the mirror-polishing process of the wafer periphery section.
[0003] By the way, an orientation flat (henceforth a "cage hula") and a notch are prepared in the location related to the crystal orientation of a wafer at the wafer periphery section, and these cage hula and the notch are used for detecting the location on a wafer periphery by the automated manufacturing installation. Therefore, it is necessary to carry out mirror polishing of the other part (henceforth a "periphery") to a cage hula or a notch also at the mirror-polishing process of the wafer periphery section.
[0004] Next, the approach of mirror polishing of the conventional wafer periphery section of a silicon single crystal wafer is explained. This approach uses the buff made of foaming resin. This approach is very fine $SiO_2$, if mirror polishing is carried out to it being also with the buff which has the slot (the total ****) which agrees the periphery and cage hula of a wafer in the configuration of that periphery and cage hula and that mirror polishing is hit. The abrasive material which melted powder etc. in water solutions, such as a sodium hydroxide (NaOH), is used. In addition, in order to carry out mirror polishing of the notch by this approach, a disc-like buff is used. Of course, an abrasive material is used also in this case.
[0005]

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## EFFECT OF THE INVENTION

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[Effect of the Invention] Since tape polish with a quick polish rate can be given compared with buffing before grinding the wafer periphery section with a buff if the effectiveness of the typical thing of this invention is explained, time amount until it makes it the smoothness below predetermined granularity will be shortened. Moreover, since buffing in which precise polish is possible can be given compared with tape polish after grinding the wafer periphery section to some extent on a tape, the polish below difficult desired granularity is attained only by tape polish.

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## TECHNICAL PROBLEM

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[Problem(s) to be Solved by the Invention] by the way, the so-called acid dirty **** crack ****** which dips a wafer in the mixed liquor of fluoric acid, a nitric acid, and an acetic acid conventionally as the etching approach of a silicon semiconductor wafer — an acid — recently [ if dirty since cost starts waste fluid processing of the etching reagent after that display flatness maintenance of the wafer after wrapping is difficult and an activity ] — an acid — dirty — instead of — alkali dirty ** — it is becoming in use. however, alkali — the time amount for smoothness being spoiled since the tooth back and peripheral face of a wafer are ruined, and backing and peripheral face processing being needed, especially making granularity of a field below into predetermined granularity by peripheral face processing, and considering as target smoothness, when dirty — an acid — there was a problem of comparing dirtily and becoming large several times.
[0006] This invention is made in view of this point, from buffing, it is a short time far, and is stabilized, and aims at offering the mirror-polishing approach and mirror-polishing equipment which can carry out smooth polish.

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## MEANS

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[Means for Solving the Problem] this invention person did not only the polish by the buff but research on the tape polish used by current [ part ] for this object achievement. This tape polish is polish using the tape which supported the abrasive grain. The concrete approach carries out mirror polishing of the wafer periphery section to mirror polishing by giving a required relative velocity between a tape and a wafer by rotating the drum which presses against the wafer periphery section the tape which it let out from the supply reel, and a new side is made to always touch the processing section by rolling round the tape by the forward-tape-wind-without-data-read-without-machine-functions reel, and winds a tape. In the research on this buffing and tape polish, at buffing, several times as much time amount as tape polish was needed for acquiring the polished surface below predetermined granularity, and there was a problem that that time amount also varied with a buff further. On the other hand, in tape polish, it found out that a limitation was in the field granularity obtained.

[0008] Then, this invention person tried to use an abrasive material and to grind with a buff, i.e., to use tape polish and buffing together, after grinding said periphery section using the tape which supported the abrasive grain in carrying out mirror polishing of the wafer periphery section. Consequently, when using mirror polishing which uses tape polish and buffing together, it turned out that it is a short time far, and it is stabilized, and field granularity can be made below into predetermined granularity from buffing.

[0009] Drawing 1 compares buffing with tape polish, an axis of ordinate shows smoothness and the axis of abscissa shows polish time amount. Although a limitation is in the smoothness obtained although the time amount for grinding to predetermined smoothness is short, the time amount for grinding to predetermined smoothness is long and that time amount differs in tape polish with a buff at buffing when this drawing 1 is seen, it turns out that smoother polish can be performed compared with tape polish. In addition, the tape with a small grain size is used as it goes to the right-hand side of drawing 1 .

[0010] After this invention grinds said periphery section using the tape which supported the abrasive grain in carrying out mirror polishing of the periphery section of the wafer after being made based on this knowledge and beveling in the periphery section of a wafer, an abrasive material is used for it and it grinds it with a buff.

[0011] Moreover, after other invention grinds said periphery section using the tape which supported the abrasive grain in carrying out mirror polishing of the periphery section of the wafer after beveling in the periphery section of a wafer and performing ARUKARIETCHI, it uses an abrasive material and grinds it with a buff.

[0012] Furthermore, other invention relates to mirror-polishing equipment, and is equipped with the tape polish equipment which grinds the wafer periphery section using the tape which supported the abrasive grain, and the buffing equipment which grinds the wafer periphery section with a buff using an abrasive material.

[0013] Since according to the above-mentioned means tape polish with a quick polish rate can be given compared with buffing before grinding the wafer periphery section with a buff, time amount until it makes it the smoothness below desired granularity will be shortened. Moreover, since buffing in which precise polish is possible can be given compared with tape polish after grinding the wafer periphery section to some extent on a tape, high polish of smoothness is attained.

[0014]

[Embodiment of the Invention] The mirror-polishing equipment concerning this invention is shown in drawing 2 . This mirror-polishing equipment 1 is equipped with tape polish equipment 2 and buffing equipment 3, and can give tape polish and buffing to the wafer periphery section now.

[0015] The cassette anchoring section A for tape polish equipment 2 to attach the cassette 4 which contained Wafer W The wafer positioning section B which positions the wafer W ( drawing 3 and drawing 4 ) picked out from the cassette 4 It has the periphery polish section E for grinding the periphery of the cage hula polish section D for grinding the cage hula O ( drawing 4 ) of the notch polish section C for grinding the notch N of Wafer W ( drawing 3 ), and Wafer W, and Wafer W. And in this tape polish equipment 2, a loader 10 is formed in the cassette anchoring section A, and the wafer transport device 11 is formed in the center. Moreover, notch polish equipment 12, cage hula polish equipment 13, and periphery polish equipment 14 are formed in the notch polish section C, the cage hula polish section D, and the periphery polish section E, respectively.

[0016] As shown in drawing 5 , a loader 10 can be equipped with the lifting device (not shown) which makes it go up and down the cassette 4 which can be held in the laminating condition for many wafers W, and band-conveyor 10a which picks out one wafer W at a time from this cassette 4, and can take out one wafer W now at a time by band-conveyor 10a sequentially from the wafer W currently held at the cassette 4 bottom.

[0017] The wafer transport device 11 is equipped with body-of-revolution 11a by which revolution actuation is carried out, and four arm 11b prepared in this body-of-revolution 11a by the motor which is not illustrated focusing on a vertical axis as shown in drawing 2 and drawing 6 , and each arm 11b is extruded by predetermined time amount in the direction of outside by the predetermined force by the air cylinder in the interior of body-of-revolution 11a which is not illustrated. Moreover, as shown in drawing 6 , adhesive disk 11c is prepared in the point bottom of each arm 11b. Each adhesive disk 11c is connected with the suction pump which is not illustrated through the air pipe (not shown) arranged in arm 11b and body-of-revolution 11a. Moreover, adhesive disk 11c can be rotated now by motor 11d.

[0018] Although notch polish equipment 12 is equipped with rotating-drum 30a and tape supporter material 30b and does not carry out a graphic display into rotating-drum 30a as shown in drawing 7 , the reel for delivery for letting out Tape T and the reel for rolling up for rolling round Tape T are formed. It is hung on tape supporter material on which part is located out of rotating-drum 30a the middle although tape T which it let out from reel for delivery is once led to outside of rotating-drum 30a and it is spirally wound almost on periphery of rotating-drum 30a 30b, the point of the tape T is further drawn inside rotating-drum 30a, and it is almost wound around the reel for rolling up. The both-way revolution of the rotating-drum 30a is carried out by motor 30c, and revolution actuation of the reel for rolling up which is not illustrated is carried out by motor 30d. With this notch polish equipment 12, pressing against the notch N of Wafer W the tape T hung on tape supporter material 30b, and rolling round Tape T by the reel for rolling up by motor 30d, the both-way revolution of the rotating-drum 30a is carried out by motor 30c, and Notch N is ground on Tape T. In that case, it is desirable to carry out the both-way revolution of the adhesive disk 11c so that the whole notch N can be ground. Moreover, as for rotating-drum 30a and tape supporter material 30b, it is desirable to constitute so that it can rotate centering on the horizontal axis which considers as a configuration movable in the direction which can approach and desert, and intersects perpendicularly with Notch N in said direction through the contact section of Tape T and Notch N further.

[0019] Although it has rotating-drum 40a and a graphic display is not carried out into rotating-drum 40a as cage hula polish equipment 13 and periphery polish equipment 14 have same composition and it is shown in drawing 8 , the reel for delivery for letting out Tape T and the reel for rolling up for rolling round Tape T are formed. The tape T which it let out from the reel for delivery is once led to the outside of rotating-drum 40a, and it is spirally wound around the periphery of rotating-drum 40a almost, and further, the point of the tape T is drawn inside rotating-drum 40a, and is almost wound around the reel for rolling up. Moreover, the both-way revolution of the rotating-drum 40a is carried out by motor 40c, and revolution actuation of the reel for rolling up which is not illustrated is carried out by motor 40d. With this cage hula polish equipment 13 and periphery polish equipment 14, pressing against the cage hula O and periphery of Wafer W the tape T hung on rotating-drum 40a, and rolling round Wafer W by the reel for rolling up by motor 40d, by motor 40c, the both-way revolution of the rotating-drum 40a is carried out, and polish of the cage hula O and a periphery is performed. It is desirable to constitute so that rotating-drum 40a can be rotated centering on the horizontal axis which intersects perpendicularly in said direction through the contact section of Tape T, and the cage hula O and a periphery, and to enable it to grind the whole chamfer.

[0020] In addition, in the wafer positioning section B, centering of Wafer W is made by the pointing device which is not illustrated. Moreover, the wafer W returned to the wafer positioning section B after tape polish termination is sent to the carrier delivery section F of Wafer W by the means which is not illustrated, without being positioned again.

[0021] The wafer positioning section G which positions the wafer W ( drawing 3 and drawing 4 ) which delivers buffing equipment 3 with the means which is not illustrated, and is sent from Section F The notch polish section H for grinding the notch N of Wafer W ( drawing 3 ) It has the cassette anchoring section K for attaching the cassette 4 for containing the periphery polish section J and Wafer W for grinding the periphery of the cage hula polish section I for grinding the cage hula O of Wafer W ( drawing 4 ), and Wafer W. And in this buffing equipment 3, the wafer transport device 21 is formed in the center. Moreover, notch polish equipment 22, cage hula polish equipment 23, and periphery polish equipment 24 are formed in the notch polish section H, the cage hula polish section I, and the periphery polish section J, respectively. Furthermore, the unloader 25 is formed in the cassette anchoring section K.

[0022] As the wafer transport device 21 has the almost same composition as the wafer transport device 11 and it is shown in drawing 2 , it has body-of-revolution 21a by which revolution actuation is carried out, and four arm 21b prepared in this body-of-revolution 21a by the motor which is not illustrated focusing on a vertical axis, and each arm 21b is extruded by predetermined time amount in the direction of outside by the predetermined force by the air cylinder in the interior of body-of-revolution 21a which is not illustrated. Moreover, adhesive disk 21c is prepared in the point bottom of each arm 21b. Each adhesive disk 21c is connected with the suction pump which is not illustrated through the air pipe (not shown) arranged in arm 21b and body-of-revolution 21a. Moreover, adhesive disk 21c can be rotated now by the motor which is not illustrated.

[0023] Notch polish equipment 22 is equipped with buff 22a made of disc-like foaming resin as shown in drawing 2 , and this buff 22a is seen from the upper part, and is supported by "KO" character-like arm 22b. And with this notch polish equipment 22, the notch N of Wafer W is ground by carrying out revolution actuation of the buff 22a by the motor which is not illustrated, pressing the periphery of buff 22a against the notch N of Wafer W, and carrying out the both-way revolution of the wafer W whenever [ corniculus ].

[0024] Cage hula polish equipment 23 is equipped with buff 23a made of cylinder-like foaming resin as shown in drawing 9 . Slot (total ****) 23b which receives the cage hula O of Wafer W is prepared in the periphery of this buff 23a. Buff 23a grinds the cage hula O of Wafer W by being able to move up and down now with the lifting device which is not illustrated and pressing the inner surface of slot 23b of buff 23a against the cage hula O of Wafer W while revolution actuation is carried out by motor 23c.

[0025] Periphery polish equipment 24 is equipped with buff 24a made of cylinder-like foaming resin as shown in drawing 10 . Slot (total ****) 24b which receives the periphery of Wafer W is prepared in the inner circumference of this buff 24a. Buff 24a grinds the periphery of Wafer W by being able to move up and down now with the lifting device which is not illustrated and pressing the inner surface of slot 24b of buff 24a against the periphery of Wafer W while revolution actuation is carried out by motor 24c.

[0026] As shown in drawing 11 , an unloader 25 can be equipped with the lifting device (not shown) which makes it go up and down the cassette 4 which can be held in the laminating condition for many wafers W, and band−conveyor 25a which contains one wafer W at a time to this cassette 4, and can contain one wafer W now at a time for Wafer W by band−conveyor 25a sequentially from a cassette 4 upside.

[0027] In addition, in the wafer positioning section G, centering of Wafer W is made by the pointing device which is not illustrated.

[0028] Thus, according to the constituted mirror−polishing equipment 1, while being able to perform the both sides of tape polish and buffing, either tape polish or buffing can be performed if needed. And when performing the both sides of tape polish and buffing, from buffing, it is a short-time far, and it is stabilized, and field granularity can be made below into desired granularity.

[0029] As mentioned above, although the operation gestalt of invention made by this invention person was explained, in the range which is not limited to this operation gestalt and does not deviate from the summary, various deformation is possible for this invention.

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## DESCRIPTION OF DRAWINGS

[Brief Description of the Drawings]
[Drawing 1] It is the graph comparing and showing the smoothness and polish time amount of the tape polish and buffing concerning this invention.
[Drawing 2] It is the top view of the mirror-polishing equipment of the operation gestalt of this invention.
[Drawing 3] It is the top view of a wafer with a notch.
[Drawing 4] It is the top view of a wafer with a cage hula.
[Drawing 5] It is the side elevation of the loader in the tape polish equipment of the operation gestalt of this invention.
[Drawing 6] It is the perspective view showing a part of wafer transport device in the polish equipment of the operation gestalt of this invention.
[Drawing 7] It is the perspective view of the notch polish equipment in the tape polish equipment of the operation gestalt of this invention.
[Drawing 8] It is the perspective view of the cage hula polish equipment in the tape polish equipment of the operation gestalt of this invention, and periphery polish equipment.
[Drawing 9] It is the side elevation of the cage hula polish equipment in the buffing equipment of the operation gestalt of this invention.
[Drawing 10] It is the perspective view of the periphery polish equipment in the buffing equipment of the operation gestalt of this invention.
[Drawing 11] It is the side elevation of the unloader in the buffing equipment of the operation gestalt of this invention.
[Description of Notations]
1 Mirror-Polishing Equipment
2 Tape Polish Equipment
3 Buffing Equipment
4 Cassette
10 Loader
11 21 Wafer transport device
12 22 Notch polish equipment
13 23 Cage hula polish equipment
14 24 Periphery polish equipment
25 Unloader

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